Lecturer-Student Interaction in Distance Learning: A Case Study on Engineering Graphics Practicals

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Abstract: Lecturer-student interaction is important for practical classes in Engineering Graphics that have specific features, e.g., working with graphical documents and individual assignments. Learning Management Systems (LMS) commonly do not offer appropriate tools for related tasks. As a result, students have to process their assignments outside the LMS, which reduces the effectiveness of the provided communication channels. Use of LMS usually assumes the student as the one who should initiate the communication. This way of working does not allow the lecturer to effectively motivate students and they is not able to track the whole process and offer timely guidance. This can be achieved through development of dedicated tools that address the specific tasks and provide a real time interaction lecturer-student. In order to check the conclusions made, a dedicated tool has been contrived allowing students to create the bill of materials of assemblies. This tool allows the lecturer to have real-time access to any students' work in its current state. The mentioned tool was tested during actual distance learning. The outcome shows greater motivation and better students' results. This confirms that implementation of dedicated tools with real-time interaction lecturer-student significantly improves distance learning and bring it closer to the classroom-based.

Keywords: Distance learning, Communication, Synchronous learning

Introduction

Distance learning is a special type of training that is designed to overcome spatial and temporal constraints with the help of modern means and technologies for dissemination of information and communication [2]. To this end, a virtual learning environment is created through specialized software that provides tools for creating, training and managing activities that are usually performed during the learning process.

With the creation and development of the Internet, new concepts such as "learning" and "online learning" have emerged, but the lack of face-to-face dialogue remains a major feature of this approach. This is the reason for

Georgieva D. & Goranov P. (2021). Lecturer-Student Interaction in Distance Learning: A Case Study on Engineering Graphics Practicals. In S. Jackowicz & O. T. Ozturk (Eds.), *Proceedings of ICSES 2021-- International Conference on Studies in Education and Social Sciences* (pp. 19-27), Antalya, TURKEY. ISTES Organization.

the many studies in this direction that do not reach a consensus. On the one hand, distance learning offers a clear structure, supports self-learning and standardized distribution of information. On the other hand, students are reluctant to distance learning due to the limited dialogue with the lecturer and primarily the lack of present exchange of ideas [5].

Interaction between the participants in the learning process is considered as a key element in distance learning [1]. For a long period of time, distance learning is considered to be of lower quality. To change this, it is necessary to use the full potential of modern means of communication and, above all, digital technologies to participate more intensively in the learning process.

There are many definitions of the term "communication" [6]: the creation of meaningful messages sent and received between individuals or teams; interactive activity caused by various factors; exchanging messages to achieve certain goals. Truly effective communication must be interactive, which means that each person must listen and respond to others. In particular, the lecturer-student communication is aimed at interactive dialogue and includes guidance and instructions from the lecturer. The lecturer must stimulate or maintain the student's interest.

According to [4], there are two main types of distance learning – asynchronous and synchronous. Asynchronous learning includes pre-prepared learning content, videos, tests and assignments. Discussions and collaborative case resolution through videoconferencing are seen as synchronous learning. Research shows that asynchronous teaching methods do not create conditions for dialogue between the student and the lecturer. Therefore, students trained through synchronous distance learning, better master the material studied. Students also prefer the presence of a lecturer even when they do not need his or her help.

Distance learning is associated with different types of interactions. In [7] the question arises whether it is possible for one type of interaction to replace the others. This largely applies to the lecturer-student dialogue, which is built into the teaching material in order to reduce the gap with the present training. Research shows that lecturer-student interaction is an integral component of the learning process and cannot be considered optional. Similar conclusions are made in [3], where it is stated that despite the more difficult implementation and higher cost of resources, the presence of a lecturer is essential for student achievement.

Issues Discussed

In the present work an analysis of the practicals in Engineering Graphics, which are conducted as online distance learning is made. The possibilities for increasing the efficiency and reducing the difference with the classroom-based training from the point of view of mastering the study material are discussed.

Analysis of Distance Learning in Engineering Graphics

Functionality of Distance Learning Systems

The following platforms are used during the learning process:

- Zoom [10];
- Microsoft Teams for Education [9];
- Moodle [8].

Zoom is a video conferencing platform. Apart from the standard features such as screen sharing, sending files, messages, whiteboard and annotations, no learning-specific functionality is offered.

Microsoft Teams for Education is a specialized distance learning platform that creates a "virtual classroom" with the necessary tools for conducting and managing the learning process such as creating assignments and storing the submitted solutions, support of grading, sharing documents. There are also many applications that are used online and help to solve various tasks.

Moodle is a learning management system (LMS) and includes the necessary functionality for conducting distance learning. An important feature is the ability to expand the functionality through additional modules. You can choose from the significant number of already developed and available modules or develop your own module that has a course-specific functionality. The BigBlueButtonBN module, which allows the creation of an online classroom via video conferencing, should be mentioned here. A number of standards are supported, such as SCORM – for content sharing and LTI – for collaboration with external tools.

Chronology of Lecturer-Student Interaction

Each student receives an individual assignment for conducting laboratory exercises in Engineering Graphics. During the face-to-face training, the lecturer controls the implementation of the assignment and gives explanations or makes adjustments in the student's work.

For effective distance learning, the lecturer must also guide the student's work within the constraints imposed by the functionality of the applied platform. Generally, this is done in two ways, depending on whether the task is accomplished manually or a CAD system is utilized.

Figure 1 illustrates the sequence of the process of interaction when document is developed by hand. To get instructions, student must scan (usually takes picture of) the document and send it to the lecturer. The lecturer c could give verbal instructions or make written corrections to the document. It should be noted that LMS systems do not usually provide image editing tools. This means that the lecturer has to use an external graphic editor, which involves a large number of technical manipulations that take considerable time.

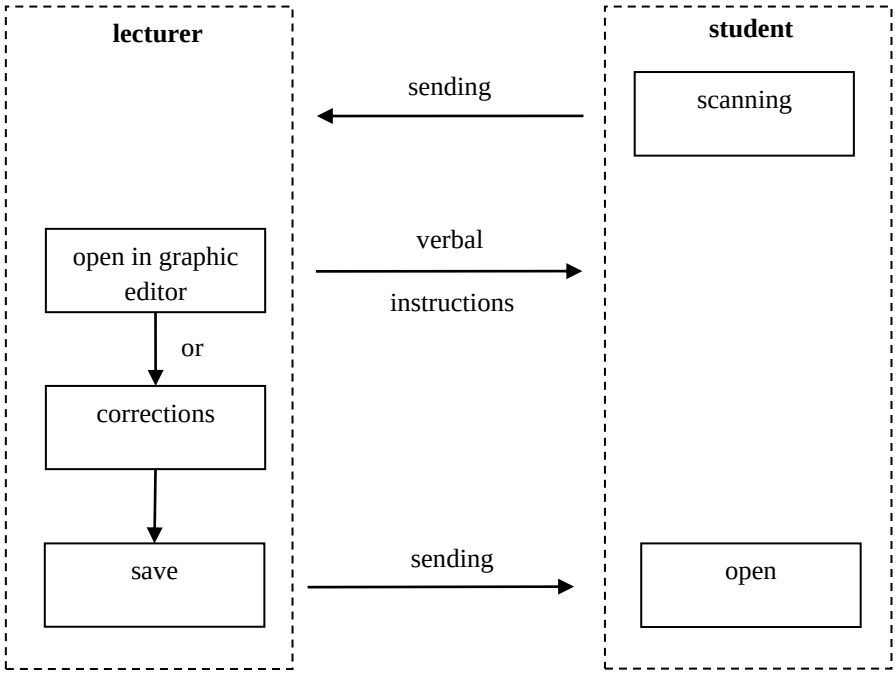


Figure 1. Lecturer-student Interaction when the Document is Developed by Hand

When working with a CAD system, the interaction takes place according to Fig.2. Here is the opportunity for the student to share the screen of his computer (or just the CAD system window) with the lecturer. The lecturer gives verbal instructions or makes a demonstration via remote control or shares the screen on his own computer

Analysis of Lecturer-Student Interaction

The described chronology of interaction creates a number of limitations on the effectiveness of the learning process. The initiative for communication comes from the student, which on the one hand reduces the opportunities that the lecturer has for his or her motivation. On the other hand, the student submits a request for communication only if in his opinion there are problems – it is possible to solve the task incorrectly, without the slightest doubt about it.

Distance learning is conducted by videoconference, which involves synchronous learning, but in practice the student's activity and control by the lecturer are shifted over time. The magnitude of this shift is determined mainly by the student and can reach a value (e.g. to the end of the exercise) that does not allow the lecturer to make adjustments to his work.

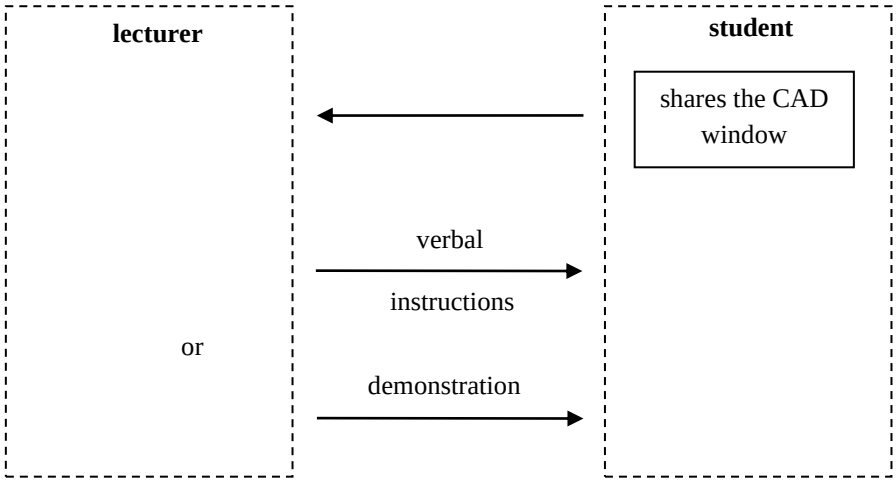


Figure 2. “Lecturer-student” Interaction when a CAD System is Utilized

In conclusion, the main limitations of distance learning in Engineering graphics, which are the result of applying only the standard functionality of the LMS, will be listed:

- the communication initiative is given to the student;
- limited prospect of the lecturer to motivate the student;
- time shift between the student's activity and the lecturer's control;
- communication is associated with a large amount of technical work, which reduces the effectiveness of the learning process.

Interaction Lecturer – Student in Real Time

Need to Create Specialized Tools

"Remote presence" usually means a video conference where all participants have their camera and microphone on. This creates the feeling that all participants are in a virtual classroom, shows that students are actually involved in the learning process and increases their motivation. Here is the place to point out that, in a sense, the personal space is violated – the participants, who are at home, have the right not to want to be filmed.

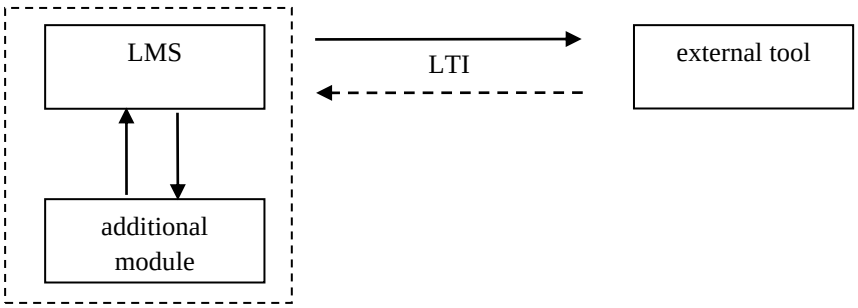


Figure 3. Integration of a Dedicated Tool with LMS

For colloquies where the learning process involves verbal discussion of case studies, the above approach is undoubtedly useful. The training in Engineering Graphics is related to the preparation of graphic and text documents and the presence of a video connection does not give additional opportunities for the lecturer to monitor the work of students. In principle, it is possible for students to exhibit their documents through the video camera, but the quality is usually low and does not allow a useful analysis of the work.

In order to increase the efficiency of the learning process in distance learning in Engineering Graphics, it is necessary to develop dedicated tools for document sharing, which allow the lecturer to monitor and guide the student's work.

Opportunities for Realization

The modern development of Internet technologies makes it relatively easy to create a specialized tool with the necessary functionality. For better organization of the activities related to the learning process, it is good to integrate this tool with LMS. This can be done in two ways – Fig.3:

- as an additional module;
- as an external tool.

The implementation of the specialized tool as an additional module practically makes it part of the LMS system. This approach involves two complications: first, the implementation must be in accordance with the system specification, and second, the system administrator would find it difficult to accept to install unknown software.

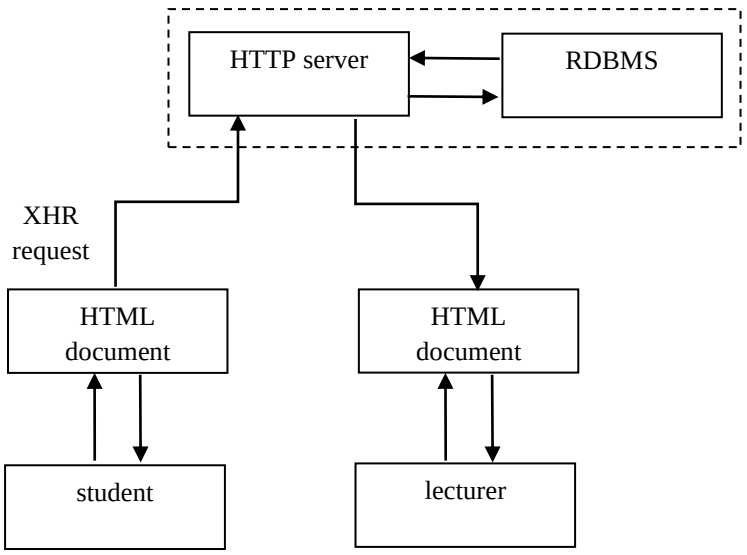


Figure 4. Block Diagram of a Dedicated Tool with Lecturer-student Interaction in Real Time

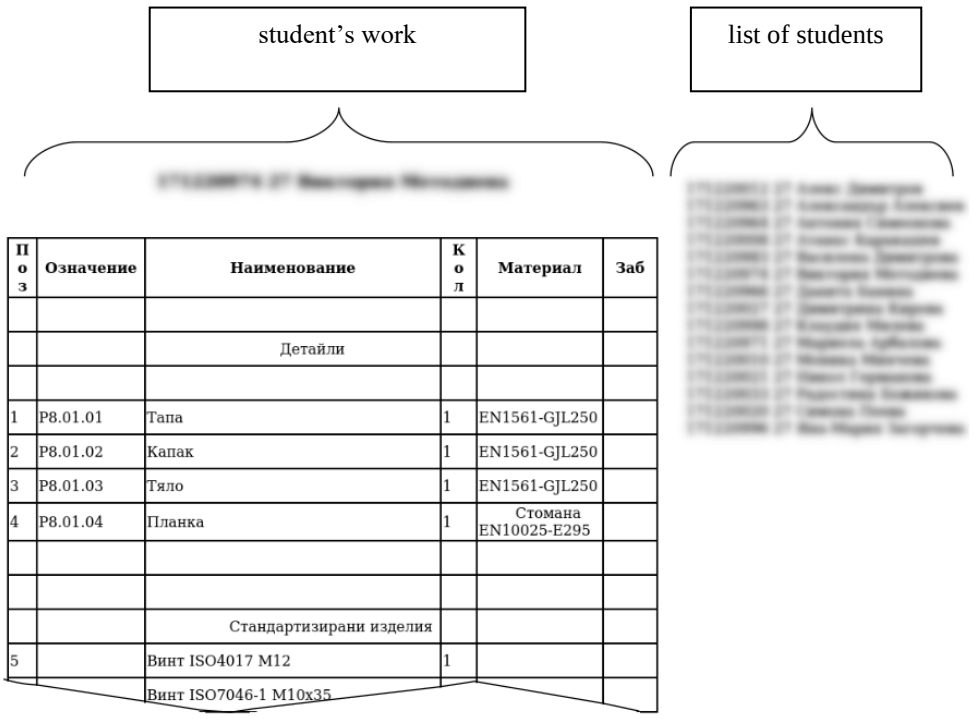
Implementation as an external tool is the easier alternative. In this case, it is possible to use already available software that offers the necessary functionality. The connection in the LMS is made in accordance with the LTI

specification, which allows both automatic identification of the student and recording the grade in the LMS (if an assessment of the task is provided).

Experimental Research

The block diagram of the created dedicated tool, allowing real-time interaction, is shown in Fig.4. The student opens from the HTTP server a page which, in addition to the template (text or graphic), also contains the necessary software for the task. The interaction lecturer-student is carried out as follows:

- the student performs the task in the HTML document, using the built-in (in the document) functionality;
- each minimum self-identifying part of the information entered by the student is automatically sent to the HTML server and saved in the database;
- the lecturer has an access to the information in the database, which allows him to monitor in real time the progress of the development of each student's solution.



Поз	Означение	Наименование	Кол	Материал	Заб
		Детайли			
1	P8.01.01	Тапа	1	EN1561-GJL250	
2	P8.01.02	Капак	1	EN1561-GJL250	
3	P8.01.03	Тяло	1	EN1561-GJL250	
4	P8.01.04	Планка	1	Стомана EN10025-E295	
		Стандартизирани изделия			
5		Винт ISO4017 M12	1		
		Винт ISO7046-1 M10x35			

Figure 5. Student Work (in Bulgarian) – the Lecturer's Point of View

It should be noted that for the student the sending of the entered information is done completely transparently and automatically, without the need for him to perform any additional actions. The recording of the information is done by means of an asynchronous XHR request, which works in the background and is invisible to the student. The start of the request itself is done automatically when an event occurs, which is defined according to the specifics of the task. Students are warned in advance that everything they enter in the HTML document is

saved automatically.

Figure 5 shows the HTML page intended for the lecturer. It contains a list of all students who attend the practical. When the lecturer indicates a student's name, he receives his work in the current state in which it is on the student's computer screen. If it is necessary to give instructions or make adjustments, he uses one of the communication channels provided by the LMS.

Conclusions

The main advantage of distance learning is the ability to conduct classes in emergency conditions, where a continuous learning process has to be ensured, provided that direct human contact must be avoided. This type of training saves time traveling to classrooms and furnishes greater flexibility in virtual lessons.

A major disadvantage for both students and lecturers is the loss of motivation. The lack of direct contact in communication complicates the creative process, the exchange of thoughts and experiences, the birth of ideas. When the number of students is large it is harder for the lecturer to monitor each of them and give individual advice and guidance. There is a significant percentage of withdrawn or given up students when the transition from classroom-based to distance learning has taken place.

Conducting practical classes in Engineering Graphics is associated with specific problems. Students must submit their work electronically. When developing paper documents, they usually take pictures with their mobile phones. In many cases, the result is poor quality, which makes it difficult for the lecturer to analyze them. Making corrections requires use of additional software products, as a result this process is slow, difficult and inaccurate.

The analysis made in the present work shows that in order to reduce these shortcomings it is necessary to develop dedicated tools that address the specific tasks associated with the training of Engineering Graphics and provide interaction lecturer-student in real time.

Lecturer-student interaction is particularly important for the effectiveness of distance learning. Here it is appropriate to point out that when it comes to the learning process, it is important not only to achieve the right decision, but also the way (sequence of actions) in which it is obtained. The student may eventually achieve the desired result, but in the wrong way, which creates the wrong habits, which can subsequently delay his development and are difficult to overcome. Therefore, the lecturer must have a view not only on the final result, but also on the whole process of solving the task and be able to guide the student.

The developed dedicated tool was tested during distance learning. The results show greater motivation and better student results. This confirms the conclusions that the creation and implementation of dedicated tools with

interaction lecturer-student in real time significantly improve distance learning and bring it closer to the classroom-based in terms of the effectiveness of the learning process.

Acknowledgements

The authors would like to thank the Research and Development Sector at the Technical University of Sofia for the financial support.

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